Providing Timely Farm Price Forecasts: Using Wheat Futures Prices To Forecast U.S. Wheat Prices at the Farm Level

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Introduction

Information regarding wheat prices is critical to market participants making production and marketing decisions, in part to help them manage price risk. Market information is also important to policy analysts who have to assess the impacts of domestic and international events upon wheat farm prices. Price information has become even more important with recent changes in U.S. agricultural policy. Passage of the Federal Agriculture Improvement and Reform Act of 1996 (1996 Farm Act) continues the farm sector's trend toward market orientation and transfers risk from the government to the private sector.

The U.S. Department of Agriculture analyzes agricultural commodity markets on a monthly basis and publishes current year market information, including price projections (except cotton). Due to policy changes and an increased desire to manage price and income risks, the need for reliable price projection models is paramount. Although USDA revised several quantitative price forecasting models to account for changes in policy (Westcott and Hoffman; Childs and Westcott; and Meyer), other procedures that use futures prices also offer opportunities for commodity price forecasting (Hoffman).

Futures prices are determined by the interaction of the expected supply and demand for a commodity. They are considered a composite indicator of expected supply and use and thus can be used to forecast short-run farm prices (Danthine; Gardner; Peck; and Rausser and Just). Hedgers and speculators evaluate a number of factors, including--but not limited to--planting intentions, weather, production forecasts, government policies, and the potential for domestic and export consumption. Hedgers deal with the actual commodity, as well as with futures contracts. Frequently, speculators have no direct connection to the cash commodity, but expect to profit from changes in futures prices.

In a recent article, Tomek has summarized the literature on the use of futures prices as a price level forecast. He states that, A futures prices can be viewed as forecasts of maturity-month prices and the evidence suggests that it is difficult for structural or time-series econometric models to improve on the forecasts that futures markets provide. However, he mentions that accuracy of a futures forecast can decline rapidly for forecasts made more than 3-4 months in advance. The reason for such a situation is the availability of information, which can change significantly over time, thereby changing price forecasts. Consequently, the development of accurate price forecasts is a challenge, especially for a more distant time. Thus, even if a futures price is an unbiased forecast, a large variance of forecast error may occur.

The question then becomes how can we convert the information present in futures prices into useful specific cash price forecasts, particularly for a crop year or other designated time periods. Most market participants understand that current futures prices provide important information about cash prices on future dates. However, these participants need to be able to forecast a cash price at a location and time when they plan to buy or sell. Thus, they need to predict the basis, which is the difference between the local cash price and the observed futures price. Similarly, policy analysts and commodity forecasters who are forecasting the U.S. season-average price need to be able to predict the monthly basis between the national producer cash price and nearby futures price. Monthly U.S. cash price forecasts are then weighted and summed into a season-average price forecast.

The objective of this paper is to construct a model that uses futures prices to provide timely and reliable forecasts of season-average prices received by farmers throughout the crop year. Wheat futures prices are used to forecast the season-average price received by farmers for U.S. wheat. Forecasts are presented for crop years 1986 through 1999 along with a forecast accuracy test. Price forecasts from the futures model are compared with the mid-point of USDA's monthly price projection released in World

Agricultural Supply and Demand Estimates (WASDE). The effects that different bases or marketing weights have upon the price forecasts are analyzed.

Forecast Framework

This section explains the forecasting model and its various components such as futures prices, basis, and marketing weights. Next, the sequential steps taken to provide futures forecasts are outlined and explained.

A season-average wheat price forecast is computed from five futures price contracts traded throughout the crop year. The forecast period covers 13 months, beginning in May, one month before the crop year begins and concludes the following May, the last month of the crop year. Initially, each month's forecast is based on a futures price and a weighted season-average price forecast is derived. Then, if an actual cash price exists for the month, it is used instead of the forecast. Consequently, the season-average price would then be a composite of actual and forecast prices. As we move closer to the end of the marketing year there are more months with actual cash prices and fewer months with forecast prices. Thus, the forecast error of the season-average price will decline as we move closer to the end of the crop year.

Forecast Model

The forecast of the weighted season-average farm price (SAP) is computed as:

$$SAP_m = \sum_{i=1}^{m-1} W_i P_i + \sum_{i=m}^{12} W_i (F_{mk} + B_{ik})$$

where:

SAP_m = forecast of the season average price made in month m.

W_i = weight for month i.

P_i = actual price in month i.

F_{mk} = observed price in month m for a futures contract that matures in month k.

B_{ik} = expected basis, which is equal to cash price in month i minus futures price in month i for a contract that matures in month k. This basis is usually a negative number.

m = 0, 1, 2, ... 12, month during which forecast is made.

i = month forecast.

k = first futures contract maturing after forecast month.

Basis

The difference between a cash price at a specific location and the price of the nearby futures contract is known as the basis. The basis tends to be more stable or predictable than either the cash price or futures price. Several factors affect the basis and help explain why the basis varies from one location to another. Some specific factors include: local supply and demand conditions for the commodity and its substitutes, transportation and handling charges, transportation bottlenecks, availability of storage space, storage costs, conditioning capacities, and market expectations. The basis computed for this analysis reflects a composite of these factors because it represents an average of U.S. conditions.

The basis used in this study is the arithmetic difference between the monthly U.S. average cash wheat price received by producers, for example in June, and a monthly average of the nearby futures settlement prices observed during June. For example, the June basis is the difference between the June average cash price received by producers and June's average settlement price of the July futures contract. A 5-year moving average basis is used in this analysis to provide a representative basis. The basis is updated at the end of each crop year.

The effects of a different basis estimate on price forecasts are analyzed. A recent crop year, 1996/97, was selected for this analysis. It was selected because it had a large forecast error, relative to other crop years, that occurred in a year of declining prices. Would a more accurate basis estimate reduce this forecast error? The revised basis pattern, an average of bases for crop years 1989 and 1991, uses a basis that is similar to the observed pattern in the beginning of the 1996/97 crop year.

Alternative basis forecasting methods could improve futures price forecasts. For example, Jiang and Hayenga found that a 3-year average basis model that included market information and a seasonal autoregressive integrated moving average (ARIMA) basis model provided a better basis forecast than a simple 3-year average basis model. Tomek discusses two types of basis forecasting models. The first one relates to bases involved with inventories carried into the next year and the second one relates to bases involved with intrayear inventories.

Monthly Weights

Monthly marketings are used to construct the weighted season-average price. Each month's weight represents the proportion of the year's crop marketed in that month. A 5-year moving average of these monthly weights is constructed and is updated annually after the release of USDA's December issue of Crop Production. Beginning in 1998 the marketing weights are published in the September Agricultural Prices report. The monthly prices, actual or forecast, are multiplied by each month's corresponding weight.

If the analyst has better information than a 5-year average, these data should be used. Perfect knowledge of marketing weights will be assumed as an alternative to assess these effects on the price forecast.

Data

Historical daily settlement prices are obtained from the Commodity Futures Trading Commission for each contract traded on the Kansas City Board of Trade for crop years 1981 through 1994. Futures prices for more recent years were obtained from Technical Tools Inc. Cash prices are from Agricultural Prices, published by USDA's National Agricultural Statistics Service. U. S. Department of Agriculture price projections are from World Supply and Demand Estimates, published by USDA's World Agricultural Outlook Board. Weights for monthly marketings are from various issues of USDA's December Crop Production. Beginning in 1998, monthly marketing weights are published in the September issue of Agricultural Prices.

Procedure

Table 1 illustrates the method used in forecasting the season-average wheat price for the crop year 1999/2000. This method produces a forecast of the season-average price based on futures settlement prices. The procedure can be used daily, weekly, monthly, or any other frequency to forecast the season-average price. The forecast frequency for this analysis is weekly. The futures settlement price as observed on each Thursday is used for each of the nearby contracts.[1]

Eight steps are involved in the forecast process:

1. The latest available futures settlement prices (line 1) are gathered for the contracts that are trading. Settlement prices for Thursday, June 17, 1999, are used for illustration (line 1). Futures quotes are used for July, September, December 1999, and March, May, and July 2000 contract settlement prices.

2. Monthly futures prices are the settlement prices of the nearby contracts. For example, the futures price for June 1999 (line 2) represents the June 17 settlement price of the July 1999 contract. The nearby (September) contract price will be used for July and August. During months which a futures contract matures, the next contract month is used because of greater stability. Futures contracts are affected by a decline in liquidity during the month of maturity. Also, a contract usually closes about the third week of the month, and using the current futures contract would lower the number of observations that could be used to calculate the average monthly closing price.

3. A 5-year moving average basis (monthly cash price minus the nearby futures price) is entered on (line 3) from the model's spreadsheet. This average is updated during the first week of July, a time when the May cash price becomes available.

4. A forecast of the monthly average farm price (line 4) is computed by adding the basis (line 3) to the monthly futures price (line 2).

5. The actual monthly average farm price is entered on line 5 as it becomes available. Since monthly cash prices are unavailable, this line remains blank until July when a mid-month June price can be used. This mid-month price is updated in August when the June cash price can

[1] Thursday is picked because there are fewer holidays and no beginning or end of week surprises.

be replaced with a price for the entire month. Then a mid-month cash price is used for July, etc.

6. The actual and forecast farm prices are spliced together in line 6. For the present marketing year, 1999-2000, there are no actual monthly prices available, so all 12 monthly prices are forecasts (from line 4).

7. The monthly percentage of wheat marketings by producers is entered on line 7 from the model's spreadsheet. A 5-year moving average is used and is updated in early January after the release of the December Crop Production report for the years 1981 through 1997. Beginning in 1998, this information is published in the September Agricultural Prices.

8. A weighted season-average farm price of wheat is then computed (line 8) by using the weights in line 7 and the monthly farm prices in line 6. A simple average annual price is also computed.

The futures forecasting model contains data for average monthly futures prices for the nearby contract, weekly futures prices of the nearby contracts, average monthly producer cash prices, and average monthly marketing weights. These data begin in 1981 and are updated to the present. The 5-year averages for bases and monthly marketing weights begin with 1981-85 data and are updated to the present. A weekly futures forecast requires an update of weekly futures prices, available cash prices, and marketing weights on a periodic basis.

Price Forecasts for Crop Years 1999/2000 and 1998/99

Season-average price forecasts are based on expectations reflected in the futures market and, if available, actual farm prices. As of June 17,1999, the futures price forecast for crop year 1999/2000 for all U.S. wheat was $2.85 per bushel. On May 6, 1999, this forecast was $2.86 per bushel and during the 7-week forecast period it ranged from $2.82 to 2.98 per bushel (figure 1). In comparison, the USDA's crop year farm price projection as released in its May and June WASDE reports for all wheat was $2.85 per bushel, 7.5 percent above the previous year's estimated all wheat price of $2.65 per bushel. [2]

The June 1999 USDA outlook for U.S. wheat in 1999/2000 was for a smaller crop, increased exports, lower ending stocks, and slightly higher prices. However, projected wheat supplies were expected to be down only slightly because of higher beginning stocks. Ending stocks were expected to be the second largest of the 1990's, although they were expected to decline from a year earlier.

Weekly futures price forecasts for the 1998/99 crop year are shown in figure 2. These forecasts are compared with the WASDE price projection to gain an idea of their reliability. Although WASDE price projections are made monthly, they are shown in a weekly frequency for ease of comparison to the futures price forecasts. Both methods' price projections were fairly similar and moved in the same direction between May 1998 and August 1998. Futures price forecasts rose relative to the WASDE projection in September through November because, in part, of a program announcement to donate U.S. wheat to needy countries and production uncertainties in the Southern Hemishpere. Starting in November 1998, the futures forecast drifted downward toward the WASDE projection partly because of weaker global demand and more aggressive pricing by Australia and the EU. [3] Both projections converged in February and the estimated price for crop year 1998/99 is $2.65 per bushel.

Forecast Accuracy for Crop Years 1986/87 through 1998/99

Forecast accuracy is examined for crop years 1986/87 through 1998/99. Data for 1981 through 1985 were used to compute the 5-year average for bases and marketing weights. A mean absolute percentage difference is computed for each of the 13 forecast months within each crop year. This difference is computed between the monthly forecast and the actual season-average farm price. Next, a crop year forecast difference is computed, an average of a crop year's 13 monthly forecast differences.

Lastly, the futures forecasts are compared with the WASDE projections, an alternative published projection of the season-average price. Because the WASDE projections are released monthly, the weekly futures forecasts are averaged for each month

[2] The mid-point of the WASDE projection range is used for comparison.

[3] One reviewer pointed out that this decline in price forecasts could be due to monthly basis estimates that were too large. While this could be part of the reason, further examination revealed that futures prices declined during this period and so cash price forecasts should decline. Additional analyses were completed assuming a perfect knowledge basis estimate and the cash price forecast also declined in this scenario.

in order to make a monthly comparison. [4] The mid-point of the WASDE projection range is used as the WASDE projection. It should be remembered that the futures forecast extracts information from futures prices and becomes a composite price forecast as monthly cash prices become available. The WASDE projection is a composite projection of econometric models, futures prices, analysts' judgement, and available monthly cash prices.

Monthly

Monthly forecast differences for both forecast methods of the season-average producer price for all wheat are shown in figure 3. As expected, the average monthly difference (using either forecast method) is larger in the beginning of the forecast period and declines over time as more information becomes available. It is interesting to note that the futures forecasts generally have a larger average difference for the first several months, May and July, than the WASDE projections. Does the futures market provide a higher risk premium during this period or does USDA have better market information? For the next 5 months, August through December, futures forecasts have a slightly lower error than WASDE projections. Does this suggest that traders' information is better than USDA's information? For the remainder of the year, January through May, both methods provide about the same forecast.

Annual

Crop year forecast differences for both forecast methods of the season-average producer price for all wheat are shown in figure 4. The average forecast difference for either method and for all crop years is 4.6 percent.

This finding tends to support Tomek's statement that over time both methods should provide similar forecasts. The futures forecast was quicker to pick up the price rise in 1995/96 than WASDE projections, but slower than WASDE projections to recognize the price decline in 1996/97, thus explaining the differences between each method's forecasts for those years.

Effects of Different Bases or Monthly Marketing Weights on Price Forecasts

Both the basis and monthly marketing weights are variables that could significantly affect the futures forecast.

Basis

As mentioned earlier, a 5-year moving average basis is used in this analysis. However, what are the effects of an alternative basis on the price forecast? The 1996/97crop year is analyzed because the largest difference between the two forecast methods occurred during this year, 3.1 percentage points. A 2-year average basis was computed based on crop years 1989 and 1991, years where the monthly basis was larger than normal. This 2-year average basis was expected to be similar to the bases in the 1996 crop year.

While the alternative 2-year basis improved the futures price forecast by .19 percentage points, the improvement was not very large (figure 5). Improvements in the futures forecast occurred in July, August, and September, but were mostly offset with declines in October, November, and December. A perfect knowledge basis was examined for the 1996/97 crop year price forecast, but it did not improve forecast accuracy. The reason why the forecast was not improved will require additional research. Additional basis forecasting techniques warrant further examination to determine their effects on the price forecast for different years.

However, improved basis forecasts for crop year 1996/97 may not help much because over 70 percent of the average forecast differences originate in the May through July forecasts. Unless those monthly forecasts are improved, it would be difficult to substantially improve the total crop year forecast.

Marketing Weights

Actual marketing weights were used for the 1996/97crop year, in contrast to the 5-year average weights, to determine the effects on the price forecast. Results of this analysis are found in figure 6.

[4] Another reviewer suggested that the monthly average price forecast should include the four weekly forecasts prior to the WASDE release date. This approach could be attempted in future research. The goal of this paper was to use available futures market information and compare its forecasts with the WASDE mid-point price.

Using actual monthly marketing weights improved the futures forecast by .2 percentage points for crop year 1996/97. Improvements in the forecast occurred in May through September and again in February through May, but were nearly offset by declines in October through January.

While actual monthly marketing weights made a minimal improvement in the futures forecast for crop year 1996/97, further analysis of alternative estimating techniques of this variable does not seem warranted for this crop year but could prove useful for other years.

Conclusions

This analysis demonstrates that the futures forecast method can provide a timely and reasonable forecast of producers' season-average prices. This procedure can provide a useful tool for commodity analysts who need similar forecasts. The futures forecast method can also provide a useful cross-check against other season-average price forecasts.

While improved estimates of bases and monthly marketing weights improved the futures price forecast for crop year 1996/97, the effect was slight. Further research should examine the effects of alternative estimates for bases and marketing weights for the other crop years analyzed in this study. Improved estimates of bases or marketing weights should improve forecasts in crop years where information is more certain. It appears that futures prices may have higher risk premiums early in the crop year forecast period when there is great uncertainty in market information.

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Table 1--Futures Forecast of U.S. Wheat Producers' Season-Average Price, Crop Year 1999-2000

	Item	June	July	August	September	October	November	December	January	February	March	April	May	July
								Dollars per bushel						
(1)	Current futures price 1/ by contract (settlement)		2.80		2.91			3.05			3.17		3.24	3.29
(2)	Monthly futures price based on nearby contract	2.80	2.91	2.91	3.05	3.05	3.05	3.17	3.17	3.17	3.24	3.24	3.29	
(3)	Plus the historical basis (cash less futures)	-0.25	-0.31	-0.21	-0.15	-0.21	-0.18	-0.13	-0.16	-0.20	+0.04	-0.20	-0.05	
(4)	Forecast of monthly average farm price	2.55	2.60	2.70	2.90	2.84	2.87	3.04	3.01	2.97	3.28	3.04	3.24	
(5)	Actual monthly farm price													
(6)	Spliced actual/forecast monthly farm price	2.55	2.60	2.70	2.90	2.84	2.87	3.04	3.01	2.97	3.28	3.04	3.24	
	Annual price projections:													
(7)	(Marketing weights in percent)	9.64	17.52	11.00	9.00	7.06	6.12	8.72	9.46	6.10	5.92	5.00	4.46	
(8)	Weighted average	2.85												
	Simple average	2.92												

1/ Contract months include July, September, December, March, and May. Futures price quotation from the Kansas City Board of Trade, June 17, 1999 settlement.

Figure 1: Producers' season-average price forecasts for all wheat, crop year 1999-2000

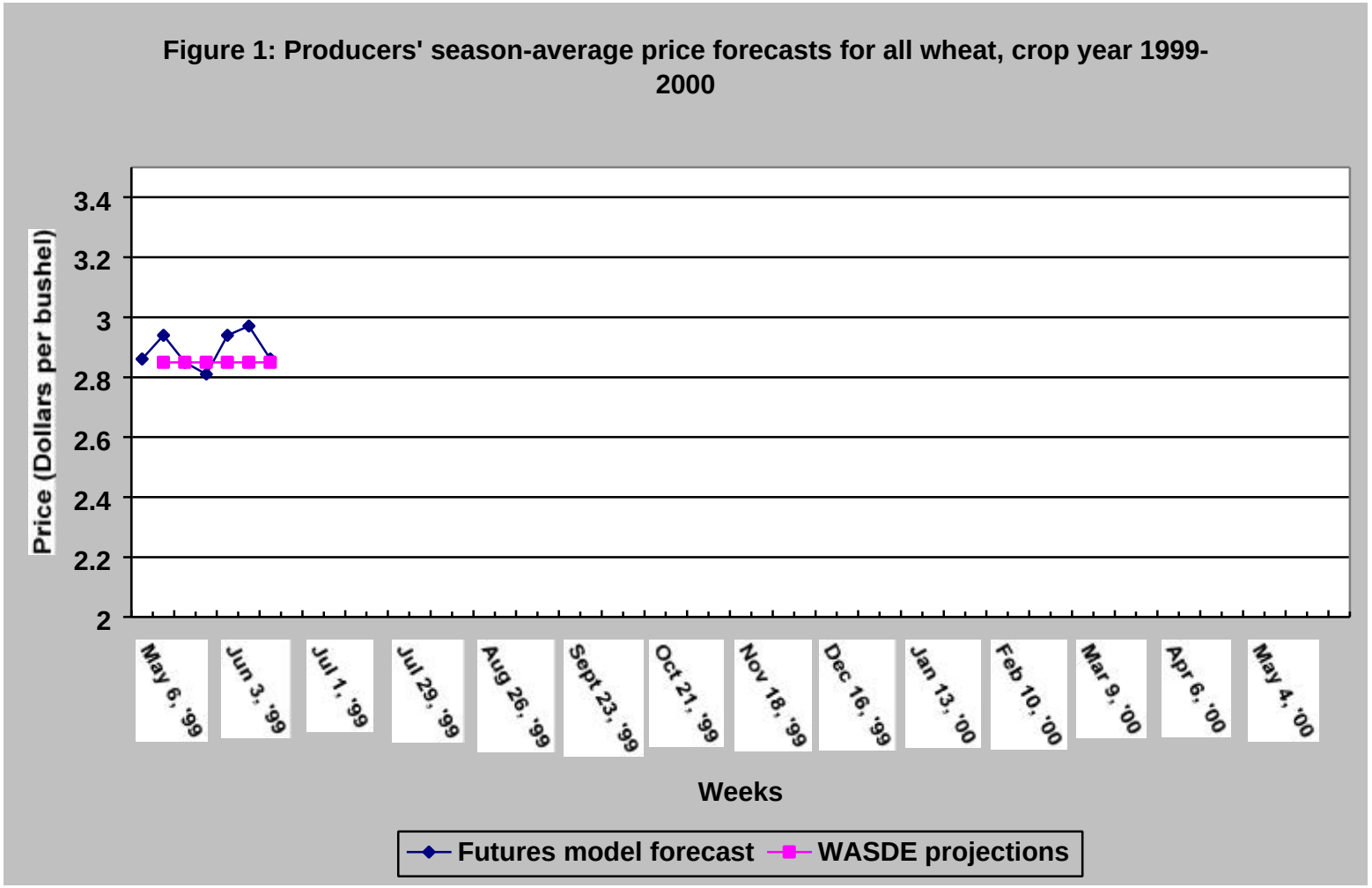

Figure 2. Producers' season average price forecasts for all wheat, crop year 1998-99

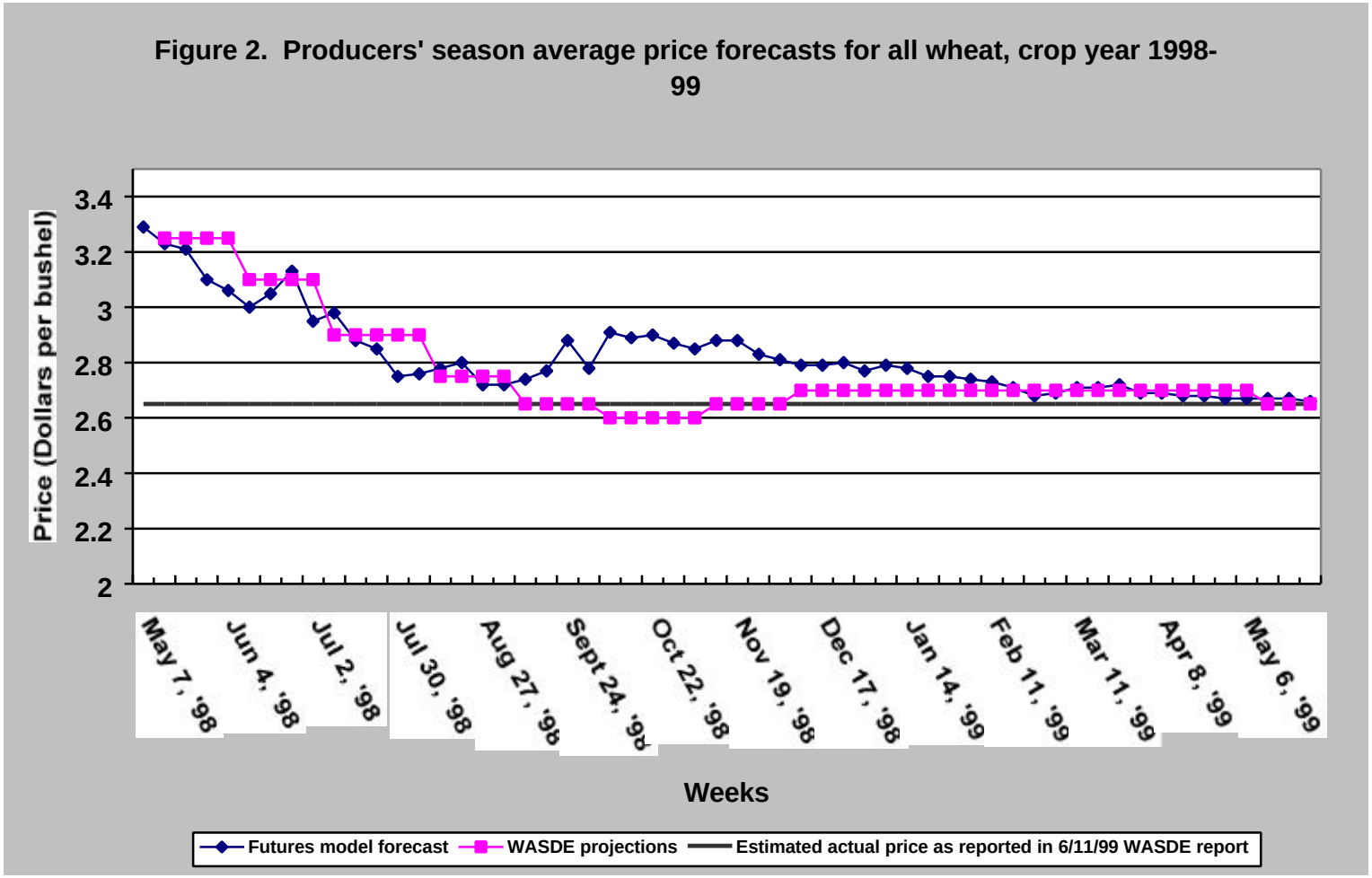

Figure 3. Accuracy of monthly season-average price forecasts for all wheat, crop years 1986-1998

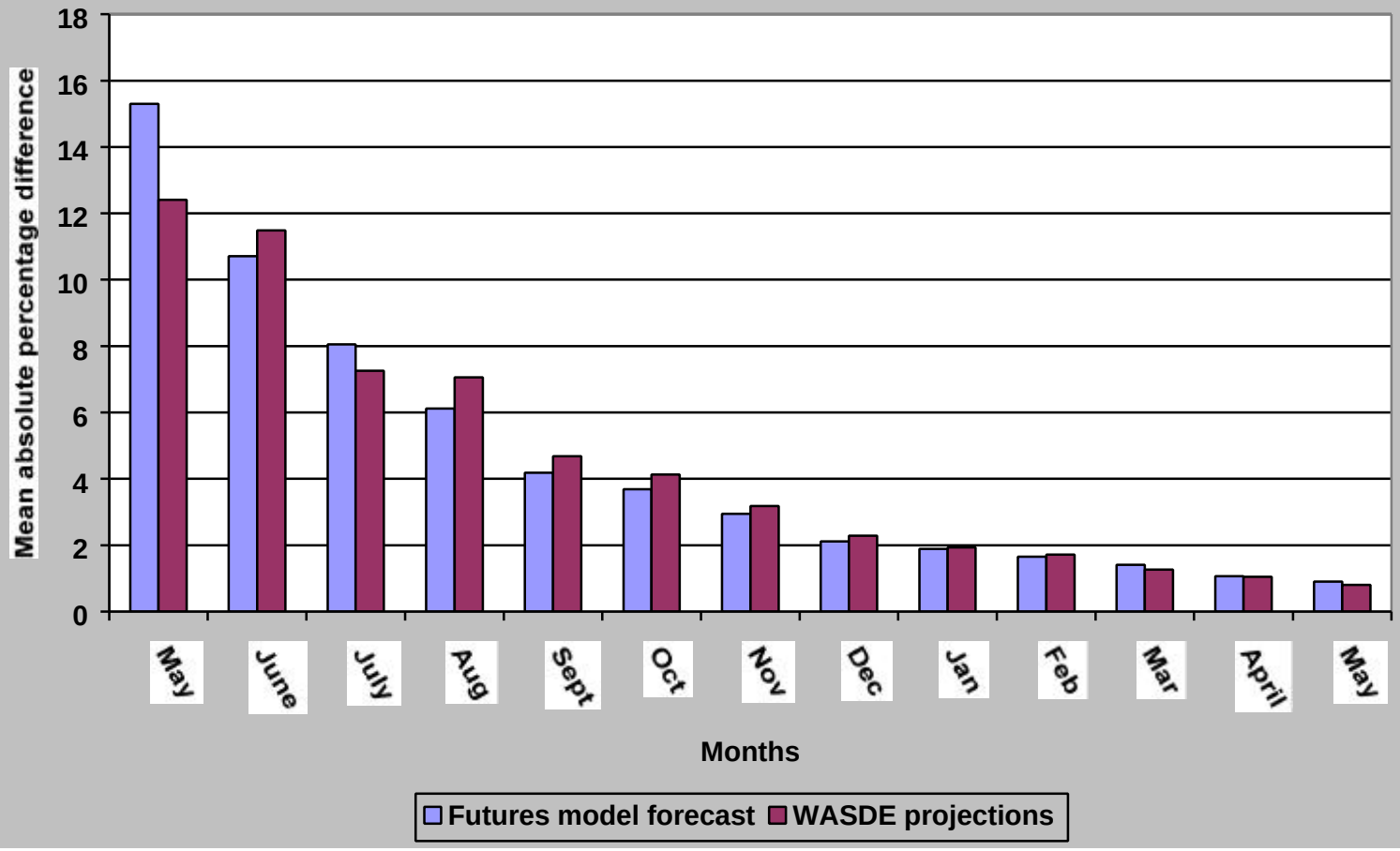

Figure 4. Accuracy of season-average price forecast for all wheat, crop years 1986-1998

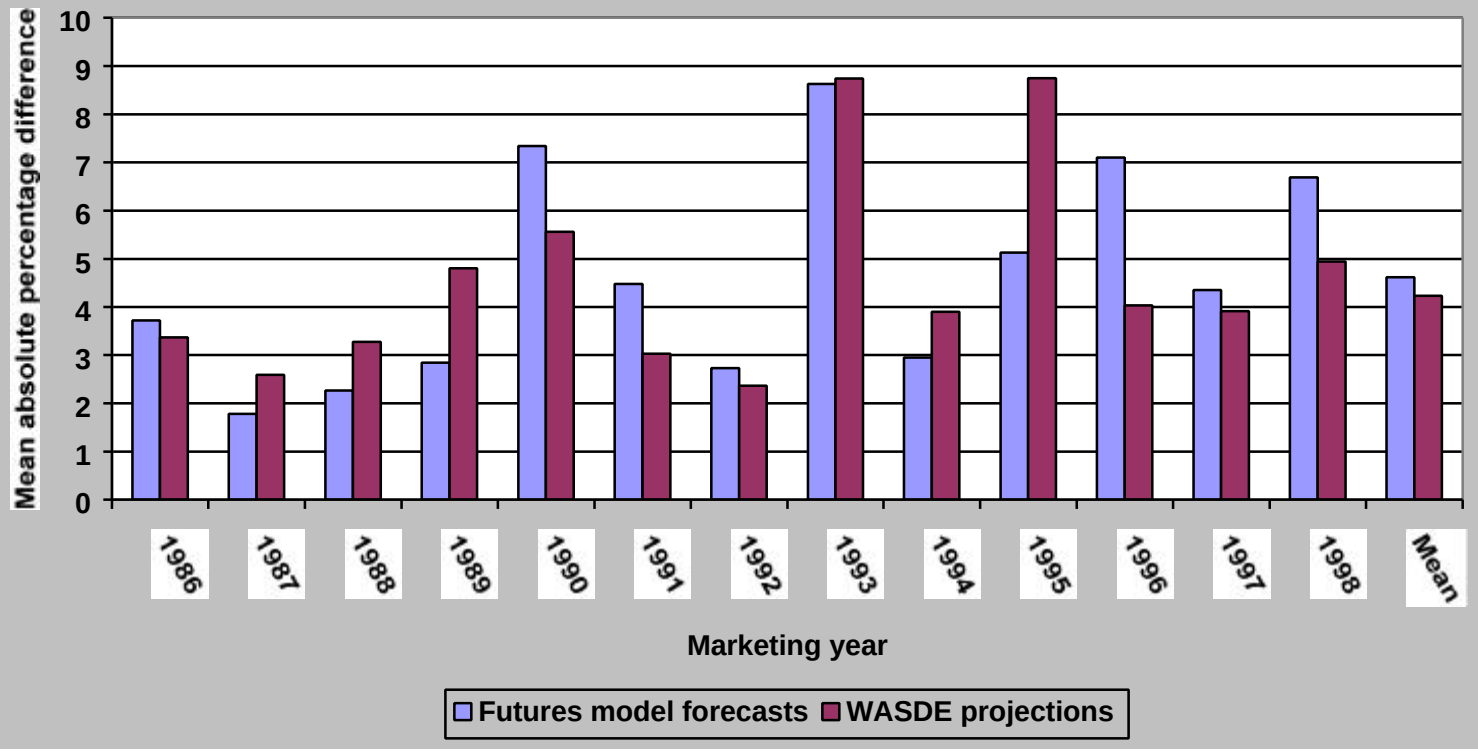

Figure 5. Effects of an alternative basis on the futures monthly forecast of season-average wheat prices, crop year 1996/97

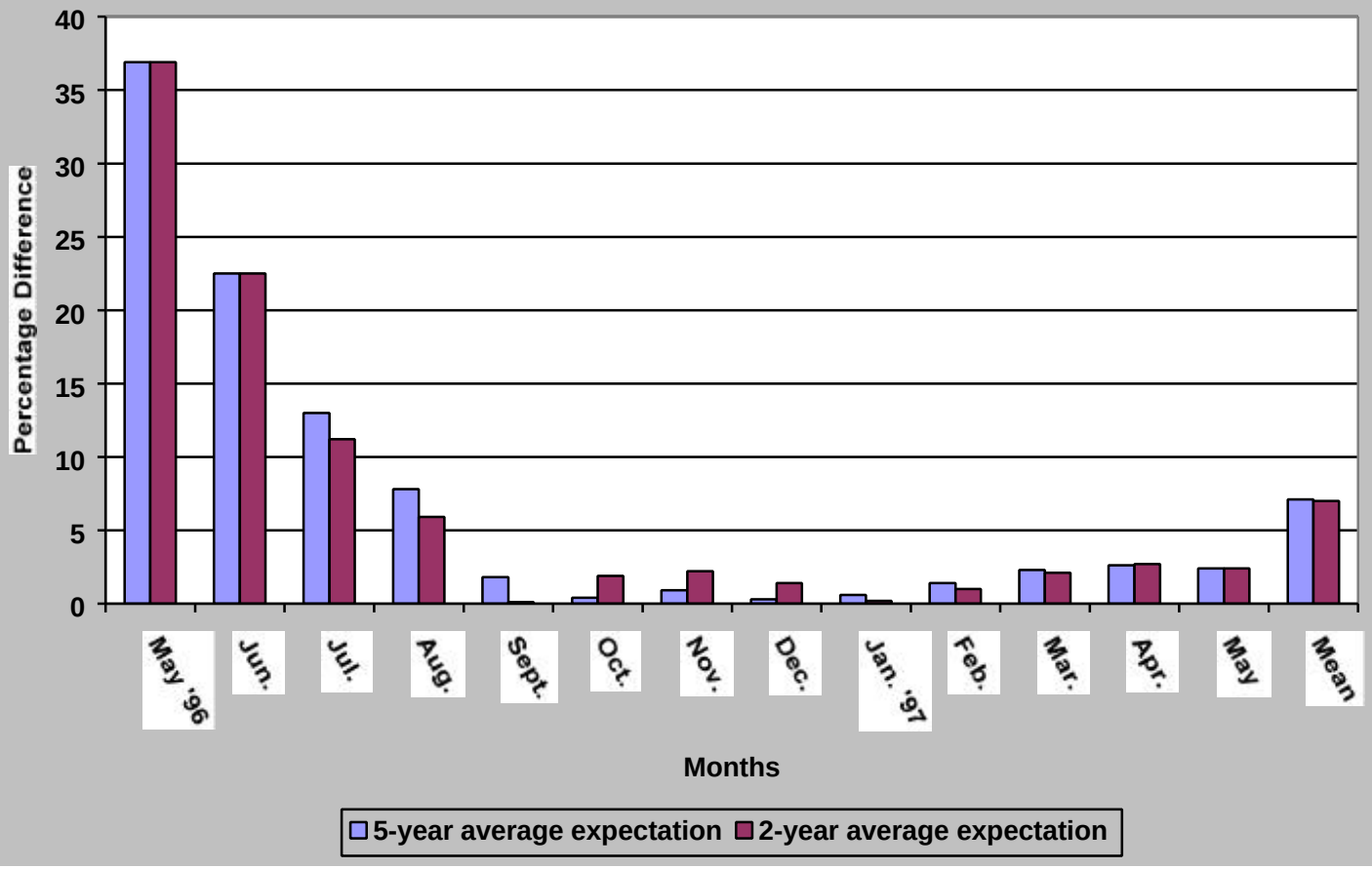

Figure 6. Effects of different monthly marketing weights on the futures monthly forecast of season-average wheat prices, crop year 1996/97